REMARKS

Examiner Kielin is thanked for the thorough and thoughtful examination of the subject Patent Application. The specification has been amended and the claims have been carefully reviewed and amended in response to his kind suggestions and valued comments.

Briefly, Applicant wishes to point out the major features of his invention. One major problem associated with the formation of damascenes is chemical mechanical planarization (CMP) because the complete removal by CMP of metal film on silicon oxide (SiO_2) is extremely difficult. One method of eliminating copper (Cu) or aluminum (Al) on silicon oxide is by overpolishing, however, dishing then appears which erodes the metal lines beyond what is acceptable. In this invention, a reverse tone photo mask is proposed which covers the damascene area and which allows the total removal of the Cu or Al from the silicon oxide through reverse etching without the prior art in-between step of leaving a thin layer of metal (or oxide in other applications) on top of the silicon oxide. When the Cu or Al on the silicon oxide is etched off those areas of the wafer not covered by the photoresist are free of redundant metal (copper, aluminum, etc.). As a result, the margin of the CMP process becomes improved because the reduced polishing decreases erosion and dishing of the metal lines, thereby improving metal continuity, reliability and subsequent photo processing.

1. Applicant asks for reconsideration of the objections to the drawings. Figures 3d, 3e, 3f, and 3g were changed to show a) the barrier layer 16 removed from area 20 from Figures 3e and 3g following Examiner's recommendations, and b) adding the numeral 16 to trenches 32, 33, 34, and 35 to indicate that barrier layer 16 was not removed from the trenches. Applicant trusts that the changes made meet Examiners expectations.

2. Applicant asks for reconsideration of the objection to the specification because of informalities on page 5, line 8. The informalities have been corrected as called for by the Examiner.

3. Reconsideration of the objections of Claims 5, 10, and 11 for informalities in (1) line 5 of claim5, (2) in line 8 of claim 5, (3) in line 3 of claim 10, and (4) on line 2 of claim 11. These informalities have been corrected as required by the Examiner.

4. Reconsideration of the objection of Claims 3 under CFR 1.75 as being a substantial duplicate of claim 1 is requested, in light of the following arguments.

Claim 3 was modified, by deleting *"said copper layer"* and adding *"is etched away"*, to better reflect the meaning and intent of the specifications on page 7, lines 13-15. Applicant, therefore, deems claim 3 no longer a substantial duplicate of claim 1.

6. Reconsideration of the objections of Claims 3, 4, and 9 under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention, is requested, in light of the following arguments.

7. Claim 3 has been amended in response to the Examiner's kind suggestion. The rewording of claim 3-- to reflect the specifications on page 7, lines 13-15, as already mentioned under 5. above-- eliminates the insufficient antecedent because claim 3 now claims the *"etching away"* of the barrier layer.

8. Claims 4 and 9 were rephrased according to Examiner's kind suggestions to follow a more appropriate claims style by using *"substituted"* and *"selected"*.

10. Reconsideration of the rejection of Claims 1-9 under 35 U.S.C. 103(a) as being unpatentable over Avanzino et al. (US 4,954,459) in view of Datta et al. (US 5,567,300) is requested, in light of the following arguments.

The methods described by Avanzino et al. (US 4,954,459) while suitable for the removal of an oxide layer over a substrate are not suitable for the removal of metal films on oxide because the metal film must be removed totally and reliably without causing dishing of the damascene. In Avanzino's method there is the choice of either

having some metal remain on top of the oxide surface without dishing of the damascene or polishing until no metal is remaining on top of the oxide surface and suffer dishing of the damascene. Neither choice is an option for the creation of damascened interconnections. It is precisely the absence of a workable method to achieve both goals that Applicant provided a method in his invention which solves this serious problem.

Applicant also wishes to point out that Avanzino etches down the exposed portions of conformal oxide layer 30 to the level of the unexposed portions of oxide layer 30, i.e., down to about the level X_2. See Avanzino et al. (US 4,954,459), FIG. 6 and col 7, lines 31-36. In a later step polishing is continued until it reaches level X_3 (see col 8, lines 12-19 and FIG. 4). To remove the last part of the oxide layer Avanzino teaches further etching (see col 8, lines 35-38 and FIG. 9). This last step, however, is problematic because it involves etching the entire surface without the benefit of a photomask and, therefore, also effects the damascened portion. Applicant's method is different and superior because it not only avoids the polishing steps between etching but the photomask also protects the damascene from the etching step.

With regards to Datta et al. (US 5,567,300), the planarization which Datta had in mind using an electromechanical removal technique is orders of magnitude away from the planarization required for an integrated circuit structure. Therefore the only similarity between Datta and Applicant's invention is the removal part through reverse plating.

Applicant's invention utilizing both a mask and an etching process is an inventive and unique combination of two separate procedures and answers a long-felt need to provide a better and more efficient method to easily polish off metal on oxide and to reduce the dishing in the wide field regions of the pattern. It is in the very nature and at the very heart of the inventive process to utilize non-related existing methods and to combine them in unusual and unexpected ways to produce a new invention. Neither Avanzino nor Datta et al. (US 5,567,300) suggest Applicant's invention. Avanzino teaches the use of polishing between etchings, failing to consider the possibility of eliminating the polishing steps, and Datta does not add anything to the art of creating Damascene wiring. In summary, Applicant considers his invention different and not obvious, there having been no prior art teachings relating to Applicant's invention. There is proposed by Examiner a combination of references that has no basis in Avanzino or Datta and can only be suggested after reading Applicant's patent application and claims.

Regarding Examiner's assertion *"that sealing a copper layer with a capping layer after planarization is well known in the art"*, Applicant wishes to point out that, as argued above, independent claims 1 and 5 are believed patentable, therefore, any part of independent claims 1 and 5 are also believed patentable.

11. Reconsideration of the rejection of Claims 4 and 9 under 35 U.S.C. 103(a) as being unpatentable over Avanzino et al. (US 4,954,459) in view of Datta et al. (US 5,567,300) is requested, in light of the following arguments.

As argued under 10. above, independent claims 1 and 5 are believed patentable, therefore, dependent claims 4 and 9 are also believed patentable.

We have reviewed the related art references made of record and feel that none of these suggest the present claimed invention.

The Examiner is thanked for his indication of allowability of Claims 10 to 12.

All claims are now believed to be allowable.

It is requested that should Examiner Kielin not find that the Claims are now Allowable that he please call the undersigned attorney at (914) 452-5863, to overcome any problems preventing allowance.

Respectfully submitted,

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